



# UNITED STATES PATENT AND TRADEMARK OFFICE

11-2

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/695,959	10/27/2003	Matthew W. Miller	MI22-2400	8008
21567	7590	02/28/2007		
WELLS ST. JOHN P.S. 601 W. FIRST AVENUE, SUITE 1300 SPOKANE, WA 99201			EXAMINER TRINH, HOA B	
			ART UNIT	PAPER NUMBER
			2814	

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	02/28/2007	PAPER

**Please find below and/or attached an Office communication concerning this application or proceeding.**

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

<b>Office Action Summary</b>	Application No.	Applicant(s)	
	10/695,959	MILLER ET AL.	
	Examiner	Art Unit	
	Vikki H. Trinh	2814	

**-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --**

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 22 November 2006.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-11, 16-42, 44-54 and 99-129 is/are pending in the application.
- 4a) Of the above claim(s) 99-102 is/are withdrawn from consideration.
- 5) ☒ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-11, 16-42, 44-54 and 103-129 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |   |  |
|---|--|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)   | 4) <input checked="" type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date: <u>20070208</u> |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)  | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)                                  |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date <u>11/22/06</u> | 6) <input type="checkbox"/> Other: _____   |

Art Unit: 2814

## **DETAILED ACTION**

### ***Acknowledgement***

An amendment filed on 11/22/2006 has been considered. Claims 1-11, 16-42, 44-54, 99-129 are pending.

### ***Election/Restrictions***

1. Applicant's election without traverse of Species I, figures 1-3 in the reply filed on 08/17/05 was acknowledged.
2. In considering of Mr. Matkin's argument, claims 103-129 are examined in this Office Action.

### ***Claim Rejections - 35 USC § 112***

3. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

4. Claims 1-11, 16-42, 44-54, 125-126, 127-129 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. In claim 1 and claim 34, the step of "treating the exposed oxide-containing surface of the capacitor dielectric region with at least one borane or silane without (or "void") depositing any material onto the exposed oxide-containing surface during any of said treating" does not have sufficient support in the original disclosure, because contrary to the claims, page 13, [0026]) of the original specification suggests that boron or silicon may retain in the material. In

Art Unit: 2814

order to expedite the prosecution process, the examiner assumes in this Office Action that the present invention includes an oxide-containing dielectric layer and that the treatment of borane or silane may be retained in the material.

Also, in claims 125-129, the original specification states that the treating step involves at least one borane **or** at least one silane, **not both** as claimed. (see specification, page 8, [0020], and page 10, [0023]). In order to expedite the prosecution process, the examiner assumes in this Office Action that the present invention includes an oxide-containing dielectric layer and that the treatment of borane **or** silane is used.

### *Claim Objections*

5. Claims 24, 26, 103, 111 are objected to because of the following informalities: In claim 24, there is no element or step limitation. In claim 26, it is not clear which layer is being treated. Is it the second electrode or the dielectric layer? The examiner assumes in this Office Action that it is the dielectric layer. In claims 103 and 111, the phrase "a thickness of only three monolayers or less" is vague and ambiguous because it does not provide a concise meaning to the terms. The examiner assumes applicants mean "a layer thickness". Appropriate correction is required.

### *Claim Rejections - 35 USC § 102*

6. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Art Unit: 2814

7. Claims 1-3, 9-11, 19, 21-26, 103, 107, 109, 125,127, 129 are rejected under 35

U.S.C. 102(e) as being anticipated by Hirano et al. (6,815,289, hereinafter as Hirano).

As to claims 1, 103,108, Hirano discloses a method of forming a capacitor for reducing current leakage, the method having the step of forming a first electrode 33, 34 (fig. 10D); forming a dielectric region 35 (fig. 10D) comprising an exposed oxide-containing surface; treating the exposed oxide-containing surface of the capacitor dielectric region with at least on silane to form a silicon dioxide layer 34 (col. 6, lines 25-40); and forming a second electrode 36 (fig. 10D) over the dielectric layer 34 and the inner surface of the second electrode contacted the surface of the dielectric layer 34 (fig. 10D).

As to claims 2-3, the first electrode 34 is a semiconductive material (col. 6, lines 25-45).

As to claims 9, 107, 125,127, 129, the treating is with a silane (col.6, lines 25-45).

As to claims 10-11, the silane is from a group as claimed. (col. 6, lines 25-45).

As to claim 19, the inner metal surface 26 is an elemental metal (fig. 10D).

As to claim 21, the inner metal surface comprises a conductive metal compound. (fig. 10D).

As to claim 23, the second capacitor electrode 36 (fig. 10D) consists essentially of metal (fig. 10D).

As to claim 24, the treating of the capacitor is to provide sufficient function (col. 1, lines 23-25).

As to claims 25, 109, the treating is inherently involved an OH group (col. 6, lines 25-45).

Art Unit: 2814

As to claim 26, the treating of the dielectric layer does not have halogen in the dielectric layer (col. 6, lines 25-45).

***Claim Rejections - 35 USC § 103***

8. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

9. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

10. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

11. Claims 4, 20, 22, 35, 46, 48, 112, 119, 121, are rejected under 35 U.S.C. 103(a) as being unpatentable over Hirano in view of Merchant et al. (6,784,478, hereinafter Merchant).

Art Unit: 2814

Hirano discloses the invention substantially as claimed, except that the dielectric layer is a hafnium oxide.

Merchant discloses an analogous device and method having a capacitor with a dielectric layer made of hafnium oxide (col. 4, lines 39-41) for providing an efficient device (col. 2, lines 3-5)

Therefore, as to claims 4, 35, 112, 119, 121, it would have been obvious to one of ordinary skills in the art at the time the invention was made to modify the invention of Hirano with the hafnium oxide, as taught by Merchant for the mentioned advantage.

As to claims 20, 46, Merchant teaches the inner metal surface comprises tungsten (col. 1, lines 39-41) for making the capacitor durable (col. 1, lines 28-35).

As to claims 22, 48, Merchant teaches that the inner metal surface comprises TiN (col. 1, lines 39-41).

12. Claims 16-18, 27, 29-33, 34, 44, 49, 50, 47, 45, 52-54, 111, 115-117, 126, 128 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hirano in view of Choi et al. (7,172,946; hereinafter as Choi)

Hirano discloses the invention substantially as claimed, except that the treating step is done in a temperature and pressure ranges, as claimed.

Choi discloses an analogous device and method having a capacitor with a dielectric layer or layers 220, 230 (fig. 8B), wherein the dielectric layer(s) is treated at a temperature and pressure within the claimed ranges (col. 2, lines 35-37) for providing efficiency (col. 3, lines 50-60)

Therefore, as to claims 16, 34, 50, 115, 126, it would have been obvious to one of ordinary skills in the art at the time the invention was made to modify the invention of Hirano with the temperature and pressure, as taught by Choi, for the mentioned advantage.

As to claims 17-18, 44, 52, 111, 116, 117, 128, it is a prima facie obvious that the treating step of Hirano in view of Choi is at least 1 second.

As to claim 27, 29-33, 49, Hirano teaches the invention substantially as claimed, except that the dielectric layer is more than one layer. Choi teaches an analogous method of making the capacitor device that has the treated dielectric layers 220, 2230 (fig. 8B). Therefore, it would have obvious to one of ordinary skills in the art at the time the invention was made to modify the invention of Hirano with the dielectric layers, as taught by Choi, so as to enhance the stress relief and improve current leakage in the device (col. 2, lines 50-55).

As to claims 29, 40-42, 115, the treating is with a silane ( $\text{SiH}_4$ ) (col.6, lines 25-45).

As to claims 30, 53, the dielectric layers 220, 230 are at least two different materials, because the layer 220 is cured and crystallized, whereas the layer 230 is not (col. 8, lines 40-60).

As to claims 31, 54, the dielectric layers 220, 230 have at least some portions are made of the same materials (col. 8, lines 40-60).

As to claims 32,45, 47, Hirano teaches the first electrode 34 (fig. 10D) is made of amorphous silicon and Choi teaches that the second electrode 240 (fig. 8B) consists essentially of metal (col. 8, lines 40-41), thereby making the device an MIS capacitor.

As to claim 33, Choi teaches that the first electrode 210 is made of a metal and the second electrode 240 is made of a metal, thereby making a MIM device (col. 8, lines 40-41).



Art Unit: 2814

13. Claim 112 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hirano in view of Choi et al. (7,172,946; hereinafter as Choi), as applied to claim 11, and further in view of Merchant.

Hirano in view of Choi (Hirano) discloses the invention substantially as claimed, except that the dielectric layer is a hafnium oxide.

Merchant discloses an analogous device and method having a capacitor with a dielectric layer made of hafnium oxide (col. 4, lines 39-41) for providing an efficient device (col. 2, lines 3-5)

Therefore, as to claim 112, it would have been obvious to one of ordinary skills in the art at the time the invention was made to modify the invention of Hirano with the hafnium oxide, as taught by Merchant for the mentioned advantage.

14. Claim 113 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hirano in view of Choi, as applied to claim 111 above, and further in view of Emesh et al. (5,452,178) (hereinafter Emesh).

Hirano in view of Choi (Hirano) discloses the invention substantially as claimed. However, Hirano does not explicitly teach specifically that the oxide-containing surface comprises aluminum oxide.

Emesh discloses an analogous method and device capacitor having a first electrode and a second electrode with a dielectric layer 60, 64, 66 (fig. 3) made of aluminum oxide (col. 9, lines 26-27) and sandwiched in between the electrodes, wherein the dielectric layer includes multi-layers 60, 64, 66, 70 (fig. 3).

Art Unit: 2814

Therefore, as to claims 5, 36, 105, 113, 122, 124, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the invention of Hirano in view of Choi with aluminum oxide, as taught by Emesh, so as to reduce cost.

15. Claims 5, 15, 36, 105, 122, 124, are rejected under 35 U.S.C. 103(a) as being unpatentable over Hirano in view of Merchant, as applied to claim 1 above, and further in view of Emesh et al. (5,452,178) (hereinafter Emesh).

Hirano in view of Merchant discloses the invention substantially as claimed. However, Merchant does not explicitly teach specifically that the oxide-containing surface comprises aluminum oxide.

Emesh discloses an analogous method and device capacitor having a first electrode and a second electrode with a dielectric layer 60, 64, 66 (fig. 3) made of aluminum oxide (col. 9, lines 26-27) and sandwiched in between the electrodes, wherein the dielectric layer includes multi-layers 60, 64, 66, 70 (fig. 3).

Therefore, as to claims 5, 36, 105, 113, 122, 124, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the invention of Hirano in view of Merchant with aluminum oxide, as taught by Emesh, so as to reduce cost.

In claim 15, the dielectric layer has a thickness dimension.

16. Claims 6-8, 28, 37-39, 106, 114, 120, 129, are rejected under 35 U.S.C. 103(a) as being unpatentable over Hirano in view of Merchant, as applied to claim 1 above, and further in view of Kudoh et al. (6,853,540) (hereinafter Kudoh).

Merchant discloses the invention substantially as claimed. However, Merchant does not explicitly teach that the treating is with at least one borane.

Kudoh discloses an analogous method and capacitor having borane coupling agent (col. 3, lines 25-30) added to the surface of the insulating layer (dielectric layer) of the capacitor device.

Therefore, as to claims 6, 28, 37, 106, 114, 120, 129, it would have been obvious to one of ordinary skill in the time the invention was made to modify the invention of Hirano in view of Merchant with the borane agent added to the surface of the dielectric layer, as taught by Kudoh, so as to prevent electrical breakdown (Kudoh, col. 3, lines 35-39).

As to claims 7, 38, Kudoh teaches the use of borane without mentioning halogen which is interpreted as being void of halogen.

As to claims 8, 39, generally the compound formula for borane in Merchant is  $\text{BH}_3$ .

17. Claim 123 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hirano in view of Merchant, as applied to claim 1 above, and further in view of Emesh and in view of Kudoh et al. (6,853,540) (hereinafter Kudoh).

Hirano in view of Merchant and further in view of Emesh (Merchant) discloses the invention substantially as claimed. However, Merchant does not explicitly teach that the treating is with at least one borane.

Kudoh discloses an analogous method and capacitor having borane coupling agent (col. 3, lines 25-30) added to the surface of the insulating layer (dielectric layer) of the capacitor device.

Therefore, as to claim 123, it would have been obvious to one of ordinary skill in the time the invention was made to modify the invention of Hirano in view of Merchant with the borane

Art Unit: 2814

agent added to the surface of the dielectric layer, as taught by Kudoh, so as to prevent electrical breakdown (Kudoh, col. 3, lines 35-39).

18. Claims 16-18, 34-35, 40-42, 44-50 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hirano in view of Merchant, as applied to claim 1 above, and further in view of Narwankar et al. (6,475,854) (hereinafter Narwankar).

Hirano in view of Merchant (Merchant) discloses the invention substantially as claimed. However, Merchant does not explicitly teach that treating comprises a temperature range of 200-500 degree Celsius and a pressure range of 1-100 Torr.

Narwankar discloses an analogous method and capacitor having a first electrode, a second electrode, and a dielectric layer 606 (fig. 6f) sandwiched between the electrodes. The dielectric layer 606 is treated or annealed at a temperature of 350-550 degrees Celsius and a pressure of few Torr (2.5 Torr to 1 atm. (Table 1, col. 12). The temperature range and the pressure range overlap the claimed ranges.

Therefore, as to claim 16, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the invention of Merchant with the temperature and pressure ranges, as taught by Narwankar, so as to provide the parameter value for the treating.

As to claims 17 and 18, 34, 44, Narwankar teaches that the treating is for 2 minutes (col. 12, Table 1) so as to provide the duration for annealing which falls within the at least 1 second, or at least 10 seconds as claimed.

As to claim 35, Merchant teaches that the exposed oxide-containing surface comprises hafnium oxide (col. 4, lines 40-41) and has a thickness.

Art Unit: 2814

As to claim 40, Merchant discloses the treating is with at least one silane (col. 4, lines 39-41).

As to claim 41, Merchant is silent about halogen, thereby the silane is used during the treating is implicitly void of halogen.

As to claim 42, generally the compound formula for silane in Merchant is  $\text{SiH}_4$  which falls within the selected options of the claim.

As to claim 45, Merchant teaches the inner metal surface comprises tungsten (col. 1, lines 39-41).

As to claim 46, Merchant teaches the inner metal surface comprises a conductive metal compound (col. 1, lines 39-41).

As to claim 47, Merchant teaches the inner metal surface comprises  $\text{TiN}$  (col. 1, lines 39-41).

As to claim 48, Merchant teaches the second capacitor consists essentially of metal (col. 1, lines 39-41).

As to claim 49, Merchant teaches the effect of treating has an inherent result as claimed.

As to claim 50, Merchant teaches the silane oxide of Merchant has an OH groups that inherently result in the treating effect as claimed because silane compound formula is  $\text{SiH}_4$  and the combination of silane and the oxide containing surface would inherently include an OH group as claimed.

19. Claims 26, 51, 110, 118, are rejected under 35 U.S.C. 103(a) as being unpatentable over Hirano in view of Merchant, as applied to claim 1 above, and further in view of Nakamura et al. (6,605,530) (hereinafter Nakamura).

Art Unit: 2814

Hirano in view of Merchant discloses the invention substantially as claimed. However, Merchant does not explicitly teach that the second electrode comprises a halogen containing gas. Note that the effect of treating with silane is the same as claimed.

Nakamura discloses an analogous method and capacitor having a first electrode 101, a dielectric layer 102, and a second electrode 103 (fig. 47), wherein the second electrode 103 comprises a halogen containing gas (col. 18, lines 14-15).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the invention of Hirano in view of Merchant with the halogen containing gas, as taught by Nakamura, so as to provide the halogen-containing second electrode.

#### ***Allowable Subject Matter***

20. The indicated allowability of claims 27-31 and 52-54 is withdrawn in view of the Applicants' new arguments and the newly discovered reference(s) as stated in the above rejection.

#### ***Response to Arguments***

21. Applicant's arguments filed 07/26/2006 have been fully considered but they are moot in view of the new rejection.

#### **Conclusion**

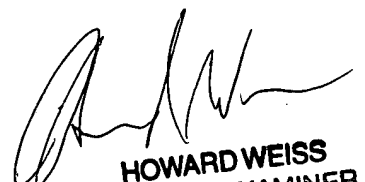
Any inquiry concerning this communication or earlier communications from the Examiner should be directed to Vikki Trinh whose telephone number is (571) 272-1719. The Examiner can normally be reached from Monday-Friday, 9:00 AM - 5:30 PM Eastern Time. If attempts to reach the examiner by telephone are unsuccessful, the Examiner's supervisor, Mr. Wael Fahmy, can be reached at (571) 272-1705. The office fax number is 703-872-9306.

Art Unit: 2814

Any request for information regarding to the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Also, status information for published applications may be obtained from either Private PAIR or Public Pair. In addition, status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. If you have questions pertaining to the Private PAIR system, please contact the Electronic Business Center (EBC) at 866-217-9197 (toll free).

Lastly, paper copies of cited U.S. patents and U.S. patent application publications will cease to be mailed to applicants with Office actions as of June 2004. Paper copies of foreign patents and non-patent literature will continue to be included with office actions. These cited U.S. patents and patent application publications are available for download via the Office's PAIR. As an alternate source, all U.S. patents and patent application publications are available on the USPTO web site ([www.uspto.gov](http://www.uspto.gov)), from the Office of Public Records and from commercial sources. Applicants are referred to the Electronic Business Center (EBC) at <http://www.uspto.gov/ebc/index.html> or 1-866-217-9197 for information on this policy. Requests to restart a period for response due to a missing U.S. patent or patent application publications will not be granted.

Vikki Trinh,  
Patent Examiner  
AU 2814



**HOWARD WEISS**  
**PRIMARY EXAMINER**